

# CHAPTER 7 QUIZ CHEMICAL SYSTEMS & EQUILIBRIUM

Knowledge

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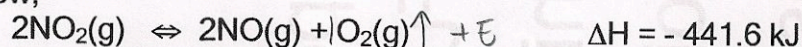
Inquiry

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## **PART B: SHORT ANSWER QUESTIONS**

Answer the following questions in the space provided.

11. For the reaction below,



in which direction will the equilibrium shift, with the following changes (give a reason for each) (10 MARKS):

- (a) oxygen is added

→  $R_x \leftarrow$  ①

→ to offset the  $\uparrow$  in  $\text{O}_2$  & produce more reactants ②

- (b) nitrogen monoxide is removed

→  $R_x \rightarrow$  ①

→ to replace the lost NO ②

- (c) energy is added

-  $R_x$  shifts left ①

- moves to the side of the reaction where the energy term isn't to produce less Energy/heat ②

- (d) volume is increased

→  $\uparrow V \downarrow P \therefore R_x \rightarrow$  ①

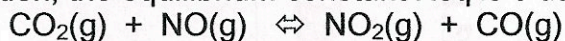
→ to make up for the decreased pressure the reaction will shift to the side with more gas moles ②

- (e) catalyst is added

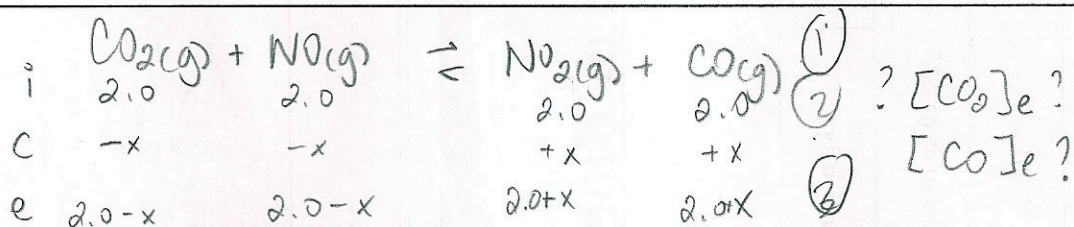
→ no effect ①

→ will speed up the time it takes to reach eq'm but not where the rxn will proceed to.

12. For the following reaction, the equilibrium constant  $K_{eq}$  is 9 at  $460^{\circ}\text{C}$ .



Initially, a 2.0 L flask contains 4.0 mol each of all four reagents. Calculate the equilibrium concentrations of carbon dioxide and carbon monoxide at this temperature. (7 MARKS)



$$[\text{CO}_2]_i = [\text{NO}]_i = [\text{NO}_2]_i = [\text{CO}]_i = \frac{4.0 \text{ mol}}{2.0 \text{ L}} = 2.0 \text{ M} \quad (4)$$

$$K_{eq} = \frac{[\text{NO}_2][\text{CO}]}{[\text{CO}_2][\text{NO}]} \quad (5)$$

$$= \frac{(2.0+x)(2.0+x)}{(2.0-x)(2.0-x)}$$

$$\therefore [\text{CO}_2]_e = 2.0 \text{ M} - 1.0 \text{ M} \quad \times$$

$$= 1.0 \text{ M}$$

$$[\text{CO}]_e = 2.0 \text{ M} + 1.0 \text{ M} \quad \times$$

$$= 3.0 \text{ M} \quad (7)$$

$$K_{eq} = \frac{(2.0+x)^2}{(2.0-x)^2}$$

$$\sqrt{9} = \frac{(2.0+x)^2}{(2.0-x)^2}$$

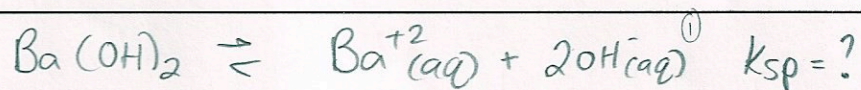
$$3 = \frac{2.0+x}{2.0-x} \quad (6)$$

$$6 - 3x = 2.0 + x$$

$$4.0 = 4x$$

$$x = 1.0$$

13. What is the value of  $K_{sp}$  for barium hydroxide if the concentration of this compound in solution is  $1.47 \times 10^{-4} \text{ mol/L}$ ? (6 MARKS)



$$[\text{Ba}(\text{OH})_2] = 1.47 \times 10^{-4} \text{ mol/L} = [\text{Ba}^{+2}] \quad (2)$$

$$[\text{OH}^{-}] = 2[\text{Ba}^{+2}] \quad (3)$$

$$= 2(1.47 \times 10^{-4}) \text{ mol/L}$$

$$= 2.94 \times 10^{-4} \text{ mol/L} \quad (4)$$

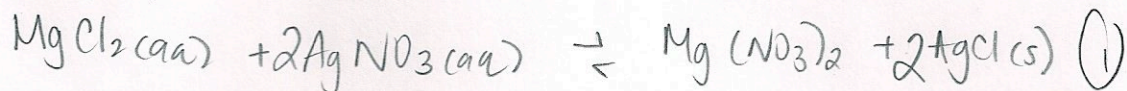
$$K_{sp} = [\text{Ba}^{+2}][\text{OH}^{-}]^2 \quad (5)$$

$$= (1.47 \times 10^{-4} \text{ mol/L})(2.94 \times 10^{-4} \text{ mol/L})^2$$

$$= 1.27 \times 10^{-11} \quad (6)$$

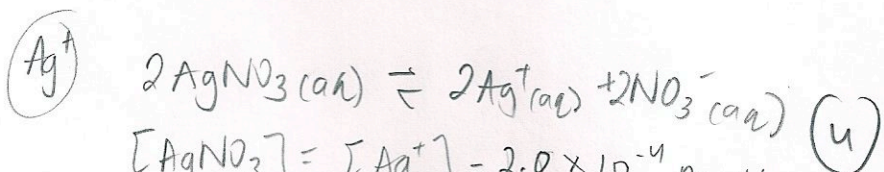
14. Will a precipitate form if 30.0 mL of  $1.5 \times 10^{-4}$  mol/L magnesium chloride is added to 30.0 mL of  $2.0 \times 10^{-4}$  mol/L silver nitrate? (7 MARKS)

? will precipitate form



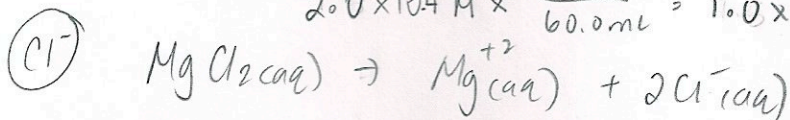
Net ionic equation:  $2\text{AgCl}(\text{s}) \rightleftharpoons 2\text{Ag}^+(\text{aq}) + 2\text{Cl}^-(\text{aq}) \quad (2)$

$$K_{sp} = [\text{Ag}^+(\text{aq})][\text{Cl}^-(\text{aq})] \quad (3)$$



$$[\text{AgNO}_3] = [\text{Ag}^+] = 2.0 \times 10^{-4} \text{ mol/L}$$

$$2.0 \times 10^{-4} \text{ M} \times \frac{30.0 \text{ mL}}{60.0 \text{ mL}} = 1.0 \times 10^{-4} \text{ M}$$



$$[\text{Cl}^-] = 2[\text{MgCl}_2]$$

$$= 2(1.5 \times 10^{-4} \text{ M})$$

$$= 3.0 \times 10^{-4} \text{ mol/L} \quad (5)$$

$$3.0 \times 10^{-4} \text{ M} \times \frac{30.0 \text{ mL}}{60.0 \text{ mL}} = 1.5 \times 10^{-4} \text{ M}$$

$$Q = [\text{Ag}^+][\text{Cl}^-]$$

$$= (1.0 \times 10^{-4} \text{ M})(1.5 \times 10^{-4} \text{ M}) \quad (6)$$

$$= 1.5 \times 10^{-8}$$

$$K_{sp} = 1.8 \times 10^{-10}$$

$\therefore Q > K$  ppt will form  $(7)$